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Journal of Pediatrics and Primary Care

Open Access

Mini Review

Volume 3 – Issue 1

Rolling Risk: Education and Toolkit Development for Pediatric Providers Surrounding Pediatric Traumatic Brain Injuries from Golf Cart Use in Suburban Communities

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Received date: 19 May, 2026 | **Accepted date:** 29 May, 2026 | **Published date:** 02 June, 2026

Citation: Azotam A and Guffey K. (2026) Rolling Risk: Education and Toolkit Development for Pediatric Providers Surrounding Pediatric Traumatic Brain Injuries from Golf Cart Use in Suburban Communities 3(1): doi https://doi.org/10.54289/JPPC2600103

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Abstract

Pediatric traumatic brain injuries (TBI) remain a leading cause of medical visits in the United States, accounting for over half a million emergency department visits, 60,000 -95,000 hospitalizations and thousands of deaths annually. Recognition of the risk to children and causes of these injuries is imperative to target appropriate preventative education and remain informed. Golf cart sales have surged by over 400% in the past five years, with increasing use in residential neighborhoods, vacation resorts, and beach communities. Despite their popularity, golf carts often lack basic safety features such as seatbelts and are frequently operated by or around children without adequate supervision. These vehicles are not designed for rapid maneuvers and are vulnerable to rollovers and collisions, especially when sharing roads with larger vehicles. Pediatric injuries typically result from ejection, overturning, or vehicular impact, with skull fractures and intracranial hemorrhages being the most common outcomes. Aside from lack of education surrounding the risk of golf carts, there are no recommendations focused on screening for the risk of golf cart injury. This practice initiative identified knowledge and practice gaps and focused on development of a toolkit for pediatric providers. This toolkit allows for screening, education and awareness of the risks associated with the increasing access and usage of residential golf carts.

Keywords: Traumatic Brain Injury, Golf Carts and Children, Head Trauma

Abbreviations: TBI: Traumatic Brain Injuries, NEISS: National Electronic Injury Surveillance System, KTA: Knowledge-To-Action, CFIR: Consolidated Framework for Implementation Research, ATV: All-Terrain Vehicles

Rolling Risk: Pediatric Traumatic Brain Injuries from Golf Cart Use in Suburban Communities

Golf carts were originally designed to support mobility on golf courses; however, their use has expanded substantially over the past several decades. Today, golf carts serve as routine modes of transportation in suburban neighborhoods, resort and beach communities, gated developments, college campuses, sporting venues, hospitals, and airports. In many residential settings, golf carts are marketed as convenient, family-friendly alternatives to passenger vehicles. Despite this expanded use, golf carts are frequently not equipped with

safety features comparable to automobiles, such as three-point seat belts, child-appropriate restraints, doors, or structural protection. In addition, many golf carts are modified to increase speed and power, further elevating injury risk.

Although children often drive or sit in the front seat of golf carts, there remains a notable lack of standardized screening tools, anticipatory guidance, and educational resources available to pediatric healthcare providers. Consequently, caregivers may underestimate the potential severity of golf cart–related injuries, particularly traumatic brain injury (TBI), and opportunities for primary prevention during routine pediatric encounters are frequently missed. Addressing this gap requires a structured, evidence-based approach that translates emerging injury epidemiology into actionable clinical practice.

Background and Review of Literature

National injury surveillance data indicate that golf cart–related injuries represent a growing public health concern. Early analyses identified nearly 150,000 golf cart–related injuries in the United States between 1990 and 2006, with injury rates more than doubling during that period **[1]**. More recent National Electronic Injury Surveillance System (NEISS) studies demonstrate that this upward trend has continued and accelerated, with more than 63,000 pediatric golf cart–related injuries reported between 2010 and 2019 and annual estimates exceeding 6,500 injuries in recent years, the majority occurring among children younger than 12 years **[2-4]**.

Pediatric TBI remains a leading cause of morbidity and emergency department utilization among children in the United States **[5,6]**. While injury-prevention initiatives have historically focused on motor vehicles and all-terrain vehicles, accumulating evidence demonstrates that golf carts constitute an increasingly prevalent and underrecognized source of pediatric neurologic injury **[7,8]**. Trauma registry and surveillance studies consistently show that children experience disproportionately high rates of head and neck injury, skull fracture, intracranial hemorrhage, and spinal trauma following golf cart incidents **[9,10]**.

Neurosurgical literature further underscores the severity of golf cart–related injuries in pediatric populations. Case series have demonstrated that children and adolescents comprise a substantial proportion of patients requiring neurosurgical evaluation following golf cart accidents. Ejection from the cart represents the dominant mechanism of injury and a sizable proportion of patients require intensive care admission and prolonged hospitalization **[10]**.

Across the literature, the mechanisms most consistently associated with severe injury include passenger ejection, rollover events, sharp cornering, and ineffective restraint systems **[7,8,11]**. Seat belt use among injured children remains exceedingly low—consistently below 10%—and the two-point lap restraints or hip bars commonly used in golf carts are poorly suited to pediatric anatomical proportions. As a result, these restraint systems frequently fail to prevent passenger ejection and may, in some cases, increase the risk of head-first impact **[9,12]**.

Despite the well-documented burden and preventability of pediatric golf cart–related injuries, anticipatory guidance on golf cart safety is not routinely incorporated into pediatric primary care **[9,12,13]**. Notably, children are most often injured as passengers rather than drivers, underscoring that age-based licensing regulations alone are insufficient to reduce injury risk. Evidence from injury-prevention research indicates that sustained reductions in pediatric injury rates require coordinated strategies that integrate clinical screening and caregiver education with broader community- and policy-level safety initiatives **[13]**.

Given the increasing incidence of pediatric golf cart–related TBI, the prevalence of modifiable risk factors, and the lack of structured guidance in clinical settings, there is a clear need for an evidence-based, implementation-focused prevention strategy **[3,4,9,12,14]**. To address this gap, this project focused on the systematic development of a brief screening and counseling toolkit designed to facilitate timely identification of risk and delivery of targeted education during routine pediatric encounters. The following Methods section describes the conceptual framework guiding this work, the processes used to develop and refine the screening and counseling instruments, and the planned strategies for evaluation and implementation.

Methods

This evidence-based practice project employed a pre-implementation design focused on development of a pediatric golf cart injury prevention toolkit guided by the Knowledge-toAction Framework **(Figure 1)**. This project seeks to translate current epidemiologic and clinical evidence into practical screening and counseling tools that support pediatric providers in delivering timely, effective anticipatory guidance during routine care. This phase emphasized rigorous development and preparation of screening and counseling instruments for pilot testing rather than evaluation of clinical outcomes. The toolkit was designed for use during pediatric primary care encounters, including well-child visits and sports physicals. Toolkit development followed best practices for pragmatic screening instruments, including theory-informed item generation, iterative content refinement, and alignment with clinical workflows **[15,16]**.

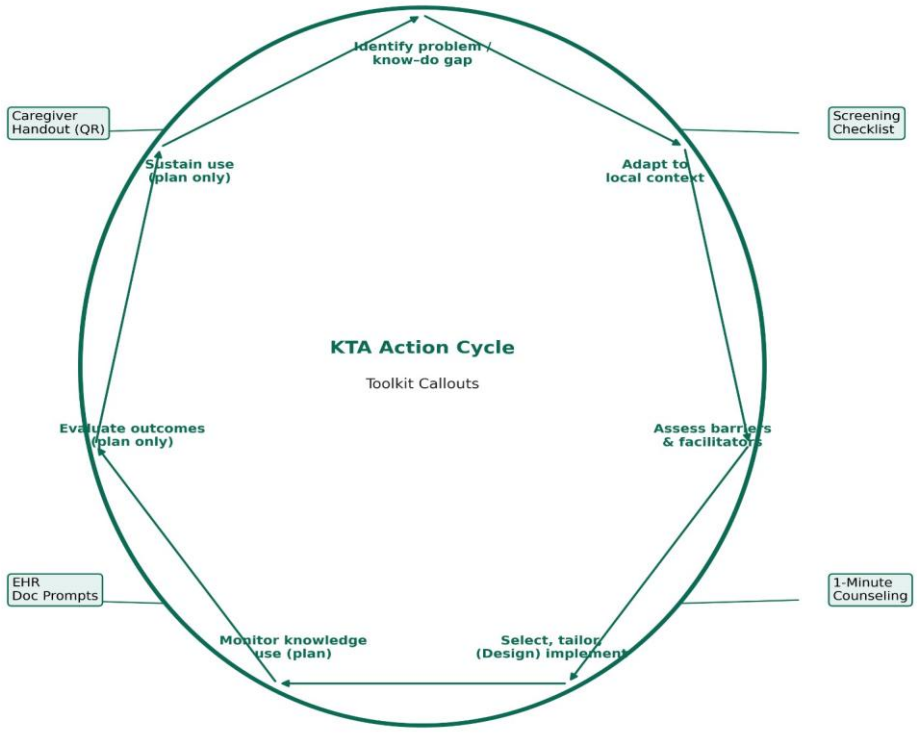

Figure 1. KTA Cycle

Knowledge-to-Action (KTA) action cycle demonstrating translation of evidence into a pediatric golf cart injury prevention toolkit. The cycle highlights identification of the knowledge-to-practice gap, adaptation through screening and brief counseling, and planned strategies for monitoring, evaluation, and sustainment supported by electronic health record prompts and caregiver education.

Conceptual and Implementation Framework

The Knowledge-to-Action (KTA) Framework guided the development of this evidencebased practice project, which aimed to create and prepare a brief, implementation-ready golf cart risk screening, and counseling toolkit for pediatric primary care. The KTA framework provides a practical structure for translating epidemiologic and clinical evidence into routine practice by integrating knowledge creation with an action cycle focused on adaptation, implementation, and sustainment **[14,16-18]**.

During the knowledge creation phase, current epidemiologic, trauma, and neurosurgical literature documenting the rising incidence and severity of pediatric golf cart–related injuries were synthesized. This body of evidence highlighted a disproportionate burden of head and neck injuries, frequent ejection events, and increasing utilization of intensive care and neurosurgical services, alongside a lack of standardized screening and anticipatory guidance in pediatric care **[9,10]**. The KTA action cycle **(Figure 1)** informed translation of this evidence into practice by identifying a clinically actionable

gap—limited provider awareness and absence of brief, feasible tools to identify golf cart injury risk during routine visits. In response, this project focused on developing a concise screening instrument paired with standardized counseling prompts that enable pediatric providers to rapidly identify risk and deliver targeted anticipatory guidance within the constraints of primary care workflows.

To strengthen implementation rigor and proactively address the multifactorial determinants for adoption of the proposed clinical toolkit, the KTA framework was complemented by the Consolidated Framework for Implementation Research (CFIR). The CFIR provides a validated framework that categorizes key implementation determinants across five domains and is widely applied in healthcare implementation research **[19]**. Integrating the CFIR with KTA **(Table 1)** allowed this project to address both the translational process and the contextual conditions influencing uptake in pediatric primary care.

The CFIR constructs informed the intervention design and planning by emphasizing adaptability, workflow fit, provider self-efficacy, and alignment with community and policy level injury prevention efforts. This approach is supported by injury prevention research demonstrating that sustained reductions in pediatric injury rates require coordinated clinical, community, and policy strategies rather than isolated education alone **[12,13]**.

Table 1. KTA–CFIR Crosswalk for Toolkit Development and Implementation

KTA Phase	CFIR Domain	Key Constructs	Project Application
Knowledge Inquiry	Intervention Characteristics	Relative advantage; adaptability; complexity	Synthesized surveillance and neurosurgical evidence to justify need for brief, low-burden screening, and counseling tools.
Problem Identification	Outer Setting	Patient needs; community context; external policies	Identified mismatch between community golf cart exposure and absence of standardized pediatric guidance.
Adapt Knowledge to Context	Inner Setting	Workflow compatibility; readiness for implementation	Designed tools compatible with timelimited pediatric primary care visits.
Select and Tailor Interventions	Characteristics of Individuals	Knowledge; beliefs; self-efficacy	Provided standardized prompts to increase provider confidence in delivering anticipatory guidance.
Implement Interventions	Process	Planning; execution; engagement	Planned pilot use with iterative feedback to refine usability and feasibility.
Sustain and Evaluate	Process / Inner Setting	Reflecting and evaluating; sustainment	Planned evaluation of acceptability and feasibility to support future scale-up.

Instrument Development and Validation

Item generation for the Golf Cart Use and Safety Screening Checklist was informed by epidemiologic and trauma literature identifying modifiable risk factors associated with pediatric golf cart injuries, including seating position, restraint use, driver age, supervision, hard cornering behaviors, and prior injury history **[7-9]**. Ten core items were developed to identify exposure, frequency of use, seating behavior, restraint, and helmet use, driving practices, history of falls or injuries, household rules, and caregiver knowledge gaps **(Appendix A)**.

Response formats were intentionally limited to dichotomous and categorical options to support rapid completion, ease of interpretation, and reduced cognitive burden in busy clinical settings, which is consistent with recommendations for creation of practical clinical tools **[16]**. The checklist functions as a trigger-based instrument where any highrisk response prompts delivery of standardized anticipatory guidance. Formal content validation using expert review and

Content Validity Index procedures is planned during pilot testing, consistent with contemporary instrument development standards **[16,20]**.

The accompanying provider counseling script and parent handout were co-developed to ensure alignment between screening and intervention. Counseling content reflects prevention strategies supported in the literature, including consistent seat belt use, avoidance of sharp turns and night-time operation, supervision by licensed drivers only, and early recognition of concussion symptoms **[11,12]**. Community and policy-level considerations—such as local rules and signage—were intentionally incorporated to reinforce upstream safety messaging. **(Appendix B and C)**.

Analysis & Planned Evaluation

The planned evaluation is aligned with the monitoring and evaluation phases of the KTA action cycle. It specifically emphasizes the implementation-relevant indicators during the initial stages of the toolkit's deployment in the clinical setting. The primary outcomes will include screening completion rates, counseling fidelity, caregiver handout distribution, and documentation consistency. Descriptive statistics and run charts will be used to assess uptake and sustainability over time **[21]**.

Provider acceptability and feasibility will be assessed using brief surveys and structured feedback. Qualitative data will undergo directed content analysis guided by implementation science constructs to identify contextual barriers and facilitators influencing adoption of the toolkit **[19,22]**. Findings from this evaluation will inform ongoing refinement of the toolkit and support future integration with community-based injury prevention initiatives to reduce the pediatric injury burden **[13]**.

Discussion

The number of golf carts used for vacation, neighbourhood travel, beach and resort towns, university tours and sporting events have increased in recent years. Naturally, children accompany their parents at many of these events. Golf carts do not have proper restraint devices for children, and the risk of ejection often is underrecognized amongst the public. Children are 1.5 times more likely to be injured from golf cart ejection than adults **[3]**. Ejection leads to neck and head injuries, and these injuries can be severe. Whether the child is the driver of the golf cart or not, the risk of injury can't be discounted or ignored. There is growth in evidence that upholds golf carts as a significant source of trauma and morbidity in children and this evidence can't be discounted **[10,23,24]**. The data collated by these authors includes studies wherein over fifty percent of children injured required hospitalization and ¼ of those children admitted to intensive care. Injuries commonly include skull fractures, intracranial hemorrhage, and cerebral contusion **[3,7,24]**. Traumatic brain injuries are three times more likely to occur in children than adults who are involved in golf cart incidents. Despite this increased occurrence, awareness of the golf cart risk lags in the general population. The American Academy of Pediatrics (AAP) **[25]** has provided suggestions but made no formal recommendations surrounding golf cart use and children **[8]**.

Traditionally, all-terrain vehicles (ATV) are considered adventurous, even dangerous. The AAP suggested children under the age of six do not ride in golf carts and have extended the ATV recommendations to include golf carts. However, despite this, the use of seatbelts and safety protocols is rare. The primary care medical home is ideally poised to identify then educate caregivers of children who are at risk. Our toolkit allows for succinct, timely screening, appropriate recommendations, and ongoing counseling.

Conclusion

This practice initiative raises awareness of the risk of pediatric TBI associated with children riding in or driving golf carts. The authors synthesized results of recent studies and developed a toolkit including development of a screening tool, counseling prompts, and a caregiver-focused pamphlet. Further work will encompass distribution of educational materials and a broader dissemination through local pediatric primary care practices and integration into a regional children's healthcare network. The results of implementation of the toolkit will be submitted for publication in the near future.

Conflict of Interest: We do not have any conflicts to disclose.

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Appendices

Appendix A. Golf Cart Use and Safety Screening Checklist

Golf Cart Use & Safety Screening Checklist (Pediatrics)

Purpose: Rapid screening to identify golf cart exposure and modifiable risks that contribute to traumatic brain injury (TBI) and other injuries.

1. Does your child ride in a golf cart at home, in your neighborhood, or during recreational activities?

■ Yes ■ No Notes: _____

2. How often does your child ride in a golf cart? (Daily / Weekly / Occasionally / Rarely)

■ Yes ■ No Notes: _____

3. Who typically drives the golf cart when your child is a passenger? (Adult / Teenager / Child / Other)

■ Yes ■ No Notes: _____

4. Is your child ever allowed to drive the golf cart? If yes, at what age did they start?

■ Yes ■ No Notes: _____

5. Does your child always remain seated while the golf cart is moving? (Always / Sometimes / Rarely)

■ Yes ■ No Notes: _____

6. Are seat belts available and used in the golf cart? (Yes, Always / Yes, Sometimes / No)

■ Yes ■ No Notes: _____

7. Does your child wear a helmet when riding or driving a golf cart? (Yes / No)

■ Yes ■ No Notes: _____

8. Has your child ever fallen or been injured while riding in a golf cart? If yes, describe the incident.

■ Yes ■ No Notes: _____

9. Are there household or community rules about golf cart use for children? If yes, what are they?

■ Yes ■ No Notes: _____

10. Do you feel you have enough information about golf cart safety and preventing injuries? (Yes / No)

■ Yes ■ No Notes: _____

Quick Counseling Prompts (if risk identified):

• Emphasize staying seated, proper use of restraints, and avoiding sharp turns/sudden stops. • Recommend age-appropriate driving (licensed/experienced drivers only) and supervision. • Discuss helmet use to reduce the risk of head injury. • Encourage adherence to local rules/laws for carts and low-speed vehicles.

Appendix B. Golf Cart Safety - Provider Counseling Prompts

GOLF CART SAFETY
Quick Counseling Prompts
(if risk identified):
"I see your child uses a golf cart. These vehicies can cause serious injuries, especially head injuries, if safety steps aren't followed. The biggest risks are falls and sudden stops. Here are some quick tips:
Emphasize staying seated, proper use of restraints, and avoiding sharp turns/sudden stops.
Recommend age-appropriate driving (licensed/experienced drivers only) and supervision.
Discuss helmet use to reduce the risk of head injury.
If your sharp turns, sudden stops, and overloading.
If your child ever hits their head, loses consciousness, vomits, or seems confused, seek medical care right away.
Do you have any questions about making golf cart ride safer?

Appendix C. Golf Cart Safety - Parent Handout

Golf Cart Safety: Preventing Head Injuries in Children

Why it matters

Golf carts are increasingly used in neighborhoods and recreational areas. Falls or ejections are the most common cause of injuries, and head, face, and neck injuries are frequent among children. Simple steps can reduce the risk of traumatic brain injury (TBI).

Top Safety Tips for Families

- Licensed/experienced drivers only. Do not allow young children to drive; follow local age and licensing rules.
- Seat everyone properly. Use available seat belts/hip restraints. Keep arms and legs inside the cart.
- Stay seated until the cart stops. No standing, hanging off, or riding on laps or rear platforms.
- Helmet helps. A well-fitted, sport-rated helmet can lower the risk of head injury, especially for higher-speed or uneven terrain.
- Slow and steady. Avoid sharp turns and sudden stops; brake gradually—especially on slopes.
- Do not overload. Match passengers to available seats and restraints; secure gear to prevent shifting.
- Choose safe routes. Avoid traffic, steep slopes, wet pavement, and uneven terrain. Use lights at dusk/night as required.
- Set family rules. Agree on supervision, speed limits, and where/when carts may be used.

If an injury happens

Seek medical care for any head impact, loss of consciousness, vomiting, worsening headache, confusion, or behavior changes. Follow your pediatrician's guidance for return to school, sports, and play.

Family Checklist (post on the fridge!)

- ■ We always keep kids seated with arms and legs inside the cart.
- ■ We use seat belts/hip restraints when available.
- ■ No sharp turns or sudden stops when children are riding.
- ■ Children do not drive; only licensed/experienced drivers operate the cart.
- ■ We avoid busy roads and unsafe terrain; we use lights at dusk/night.
- ■ Helmet considered for higher-risk rides (speed/uneven terrain).
- ■ We have clear family rules and supervision for cart use.

This information is for education only and does not replace medical advice. Ask your pediatric clinician for guidance specific to your child.